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Floating Laboratory for Study of Aquatic Organisms and Their Environment

ircular 356

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By
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ABSTRACT

The National Marine Fisheries Service has built a floating laboratory to study environmental problems in the Columbia River. The barge that supports the laboratory was obtained from the U.S. Navy. Installation of a complex electrical and water supply system plus biological research equipment aboard the barge have made it possible to conduct research near sites where problems are expected to occur.

INTRODUCTION

Man's steady encroachment is rapidly changing the environment of major rivers and estuaries. The problem is becoming particularly acute in the Pacific Northwest. Large runs of fish rely on these waterways for migration, reproduction, and feeding. The survival of economically important species depends, in no small part, on the constant and continuing activities of many research and management agencies.

Environmental research is being broadened from that of investigating problems after they occur to that of predicting what will happen in the future. Possible effects of certain changes on living creatures are determined; we hope that detrimental effects can then be averted and beneficial results obtained.

Ample background knowledge is essential to predict and to prevent problems, particularly of the aquatic environment. Such studies will yield results with the greatest degree of reliability when they are conducted on organisms collected at a proposed site for water use. The organisms are then bioassayed in water pumped from the same environment.

The NMFS (National Marine Fisheries Service) has now entered into predictive research. In so doing, NMFS has recognized the need for facilities that will enable the biologists to study aquatic organisms in their own environment.

A large floating platform was needed to house a self-contained testing facility. Such a facility could be moved to various geographical areas for critical "on-site" examination of the effects of environmental variables on the aquatic organisms.

This paper describes such a facility. The NMFS is now investigating the effects of environmental changes (primarily water temperature) on the fish in the lower Columbia River and estuary.

THE FACILITY

The facility was assembled on a surplus barge acquired from the U.S. Navy. The barge is 32 ft x 110 ft in outside dimensions. A 26 ft x 80 ft metal building on the main deck has been converted to laboratory and office space. Four of six ballast compartments below deck were converted to maintenance shops and to storage and work spaces. Two compartments—one forward, and one aft—are used for ballast. About 6,000 sq ft of floor space on the two decks is available. The facility provides a stable platform and, with water storage tanks full, draws only 4 ft of water. A plan view of the main and lower decks is shown in Figure 1.

WATER SYSTEMS

Two methods are used to supply water to the facility. Untreated river water is pumped aboard, and treated domestic water is pressure-fed.

Untreated Water Supply

Untreated river water is used in the test tanks and aquaria for all environmental studies. It is pumped at a constant rate of 200 gallons per minute (gpm). The water is distributed to two 6-ft-diameter, 1,000-gal storage tanks, equipped with heating and cooling units. Water in the storage tanks is continually circulated through four sand filters (Fig. 2). The water from the storage tanks is gravity fed to the test tanks, from which it drains back to the river. All of the pipes carrying the untreated river water are plastic.

Water is also pumped from the river to supply eight fish-holding tanks and two test tanks in the fish-holding room (Fig. 3). The two test tanks are designed specifically for testing the effects of predation on fish subjected to lethal and sublethal temperatures. Chilled river water can also be pumped to three of the holding tanks and the two test tanks.

Domestic Supply

Domestic water for personal use is supplied by pressure to the facility through 1-in plastic and galvanized pipes. Three sinks are provided with hot and cold water; drainage is by gravity except for the sink on the lower deck, where disposal is by pumping.

ELECTRICAL SYSTEMS

Electrical power is provided through two service lines: (1) a 220-v single- and three-phase service provides power for pumping and chilling the water and for lights, space heaters, fans, and other general requirements and (2) a 440-v, single-phase line provides power for a 100-kw heater for the experimental water supply. Wiring diagrams are shown for the upper deck in Figure 4 and for the lower deck in Figure 5. A contactor has been installed on the 220-v three-phase service to protect all equipment against a "single-phasing" condition that can cause motor damage.

MAIN DECK LAYOUT

The metal building on the main deck houses the fish-holding room, laboratories, and office; other spaces used are the forward and aft decks. All water and electrical systems are controlled from the main deck.

Forward Deck

The forward deck, outside the building, contains the two storage tanks and equipment to hold, filter, heat, and cool water from the river. The two storage tanks, with heated and cooled water, are on a raised platform. Four sand filters, two for each of the cold and hot water systems, are under the storage tanks. When filtered river water is required, water from the storage tanks is circulated through the filters. Electrical controls for the cooling and heating of the water for the storage tanks are housed in boxes nearby (Fig. 6).

Fish-Holding Room

The fish-holding room contains four 6-ft-diameter tanks (800 gal) and four 4-ft-diameter tanks (350 gal). Water is pumped directly from the river with a 200-gpm pump, which supplies a complete interchange of water in each holding tank (at maximum capacity) in less than 2 hr.

Two test tanks, each 2 ft x 3 ft x 6 ft (300 gal), are on stands. A separate pump supplies filtered river water to these tanks.

Two freezers (36-cu-ft capacity each) provide storage for biological samples and fish food. An air compressor supplies emergency air to all fish-holding and test tanks. Sliding

doors on both sides of the room provide a passageway of flexible size to and from the building. Sections of the guard rail can be removed to provide access from the dock or river when supplies, equipment, or fish are brought aboard.

Laboratories

Two wet laboratories (total floor space 450 sq ft) are located in the metal building (Fig. 7). Each is equipped with 24 50-gal portable wooden test tanks, which can be manipulated to provide a wide range of test requirements. Each tank has temperature and flow controls for water and controls to provide constant light. Water from the storage tanks enters the test tanks through mixing valves and then drains into the river. Each test tank can be supplied with a complete exchange of water within 1 hr. A number of separate tests can be carried out simultaneously in these two laboratories. Each wet laboratory contains a desk, metal storage cabinet, several plexiglass aquaria, and equipment for monitoring water temperature.

A biological laboratory (110 sq ft of floor space) contains storage cabinets and counter space for binocular and monocular microscopes, a balance, a refrigerator, and devices to count plankton and to analyze fish stomach samples.

A chemistry laboratory (80 sq ft of floor space) contains analytical, chemical, and physical monitoring equipment, two storage cabinets, and a sink. The equipment includes a water distillation unit, pH meter, O_2 meter, Van-Slyke gas-analysis unit, atomic absorption spectrophotometer with attachments, glassware, and miscellaneous chemical apparatus. This space also serves as a photolaboratory and darkroom.

Office

The office (225 sq ft) contains three desks, filing cabinets, book shelves, and radio communication equipment. Access to the office is from the aft deck or the aft entrance (Fig. 8).

Loading and Display Room

An aft entry, port and starboard, provides access to an open room (over 1,000 sq ft of floor space) that is used for loading and display. This section of the metal building has sliding doors on both sides and a sliding roof. Six display aquaria are located here, as well as recording instruments for physical monitoring of the river water. The equipment includes a metal beam and an overhead trolley crane. Space for storing life jackets and cleaning equipment is also available. A ladder well leads to the lower deck.

Aft Deck

Sensing units for monitoring water temperature and flow are suspended from the aft deck. This deck space has been reserved primarily for future installation of hydrologic and meteorologic instrumentation.

LOWER DECK LAYOUT

Over 2,100 sq ft of floor space on the lower deck was made available by cleaning and converting four "ballast" tanks into compartments. The four compartments are used for storage, maintenance, and work areas. The lower deck is about 4 ft below the water line. Water supply and drain lines are suspended from the ceiling in the lower compartments to provide access for repairs, modifications, and inspection.

Storage Compartment

The forward compartment (576 sq ft) is used for storing hardware, nets, supplies, and standby equipment.

Maintenance Shops

About 1,000 sq ft of floor space in the two center compartments is used for welding, woodworking, and outboard motor shops (Fig. 9).

The welding shop contains an arc-welder, acetylene torch, power grinder, and work bench. The woodworking shop is equipped with power and hand tools, in addition to a 9-in radial arm saw and 18 ft of counter space. Equipment in the outboard motor shop includes a work bench, motor rack, test tank, and specialized testing aids and equipment.

Blowers are installed in each shop for proper ventilation. The access area to the lower deck is adjacent to the woodworking shop.

Conference Room

The aft compartment (570 sq ft) contains a conference table, drafting table, and storage locker for photographic projection equipment. It also contains personal lockers, a sink, cupboards, and a refrigerator. Display and bulletin boards, a projection screen, and a blackboard are located in this room (Fig. 10).

SAFETY FEATURES

Safety is a prime concern aboard the vessel. Safety features and rules, unique to this particular facility, are a part of the safety program. Precautions have been taken to prevent accidents in the maintenance shops—for example, protection for eyes and limbs.

Fire protection includes: (1) CO_2 extinguishers throughout the facility on both decks, (2) fire ax and sand pail, (3) fire hose with city water, (4) fire hoses with river water (two 200 gpm electrical and two 200 gpm gasoline pumps), and (5) personnel assignments and responsibilities.

A water level warning system, installed in the bilges, activates an alarm horn and simultaneously disconnects the electrical service to the fish-holding water supply pumps.

First aid kits are placed throughout. A stretcher is available on the main deck (location of safety equipment is shown in Fig. 11). All hands are instructed in resuscitation techniques. Nonslip surfaces are provided in danger areas.

Life jackets are available and used when working over or near the water. Hard hats are available for all personnel.

A monthly safety meeting is held aboard the facility, and each member of the crew is encouraged to make observations and recommendations concerning operational safety.

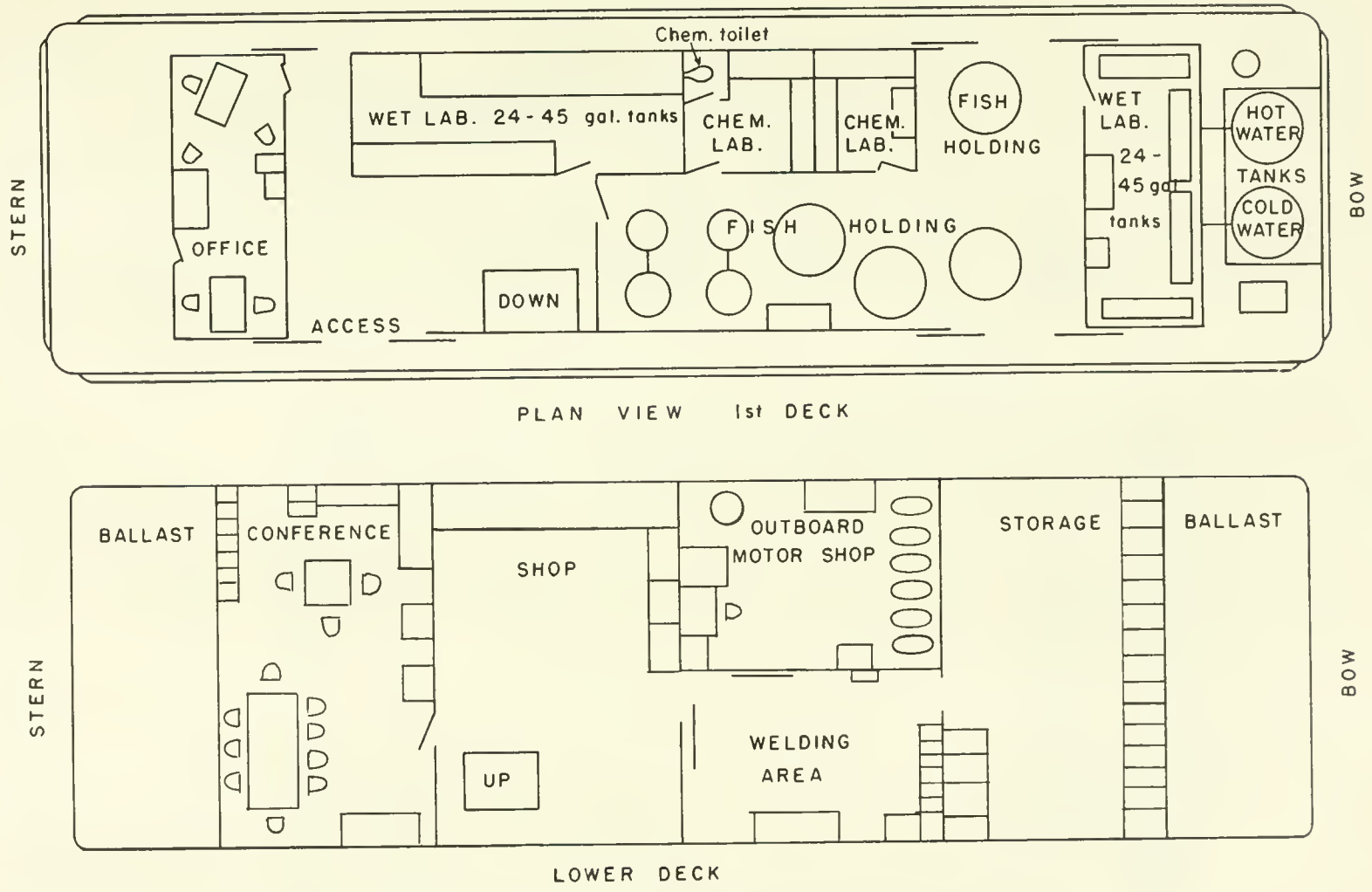


Figure 1.—Plan view of main and lower decks of floating facility.

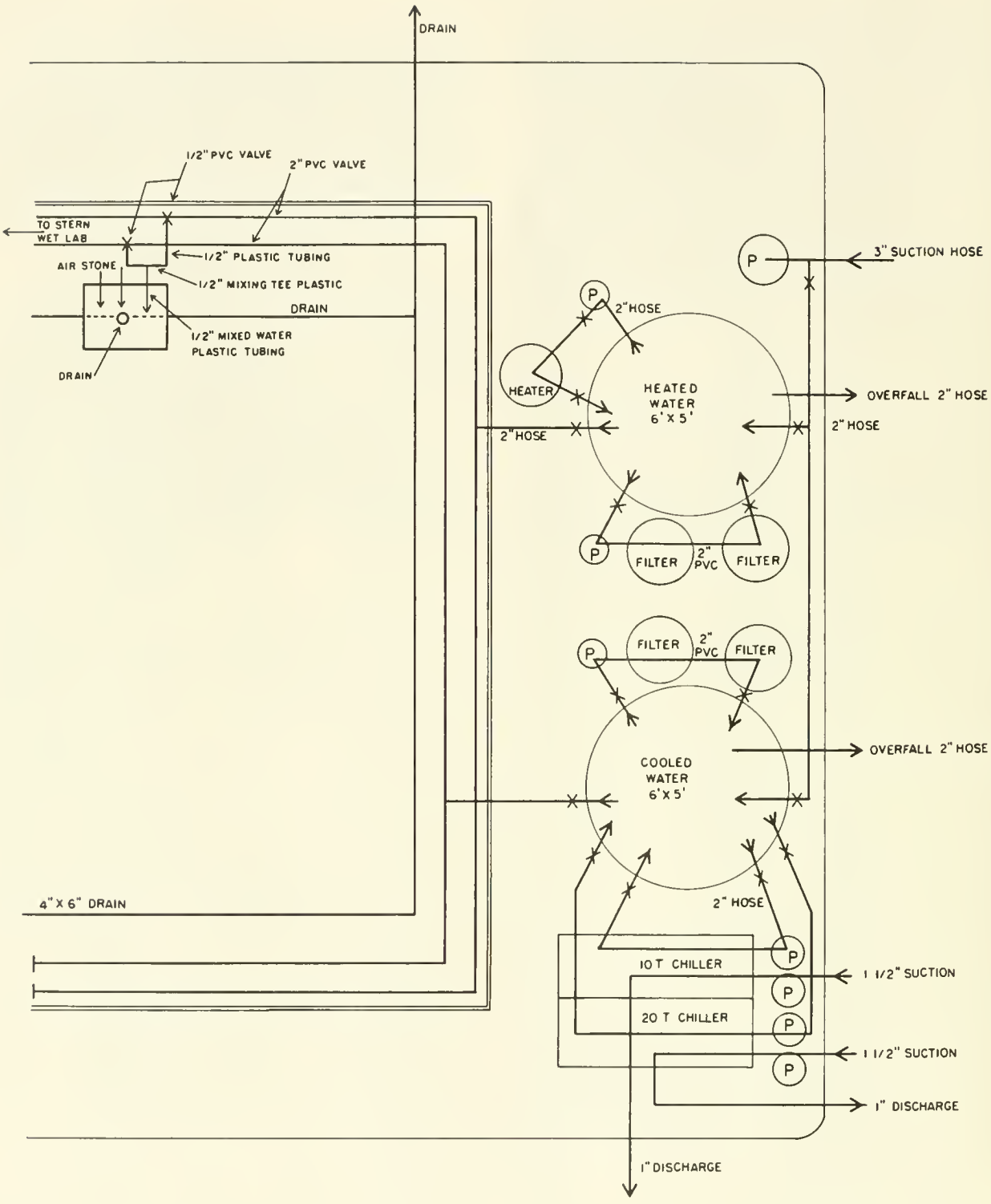
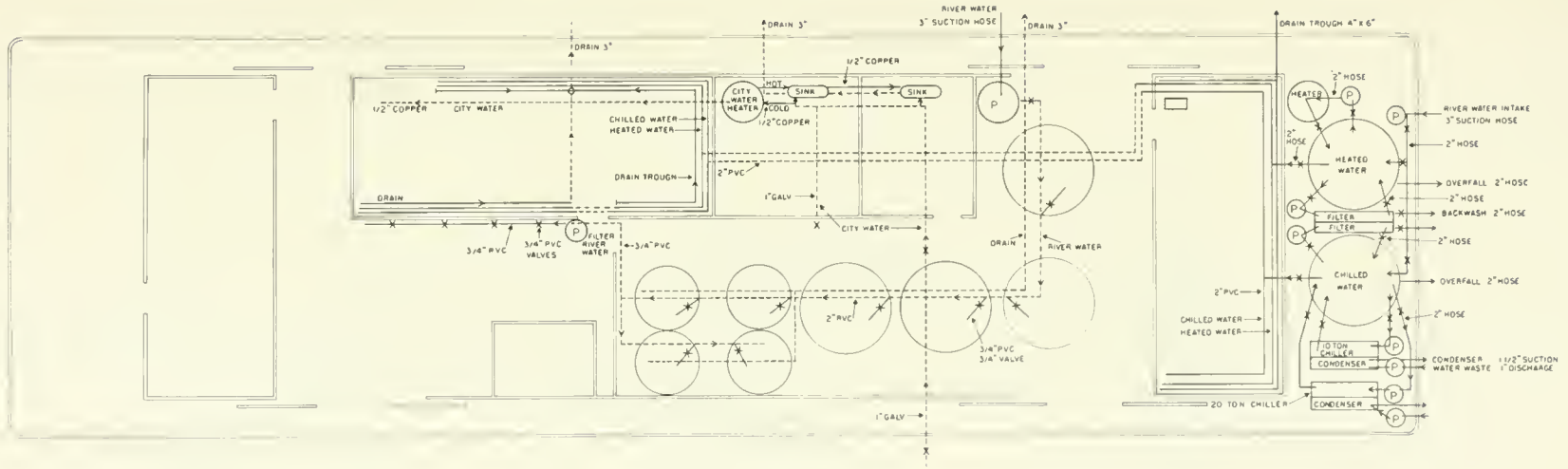
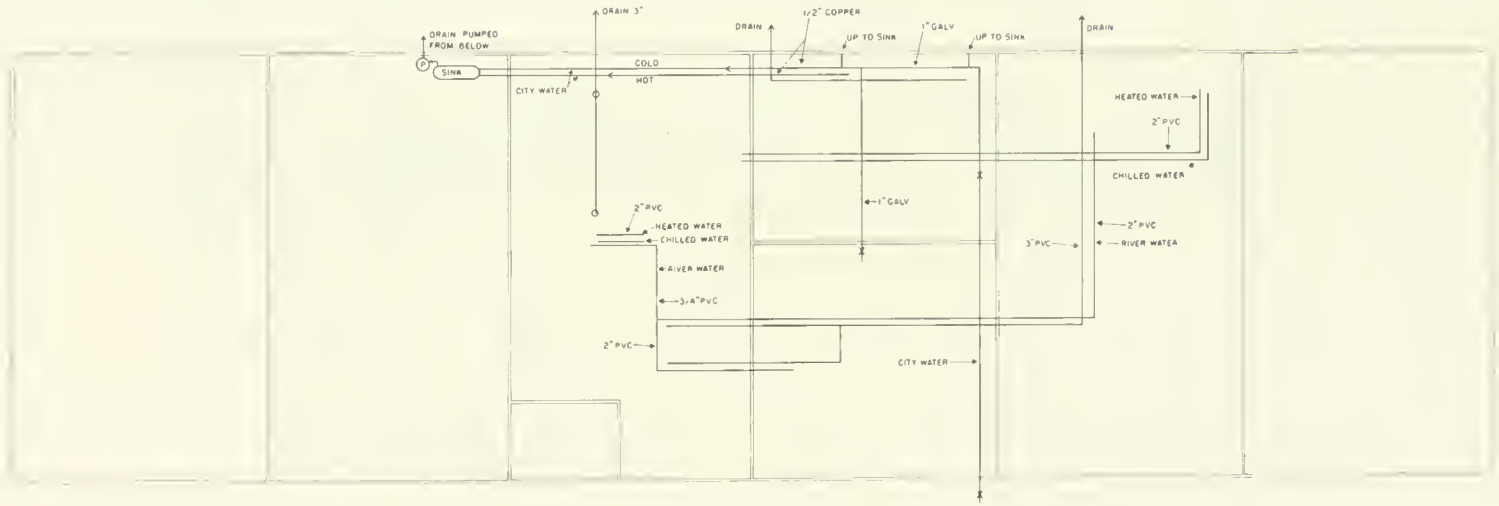


Figure 2.—Diagram of water circulation system for untreated river water through filters, heater, and chiller.

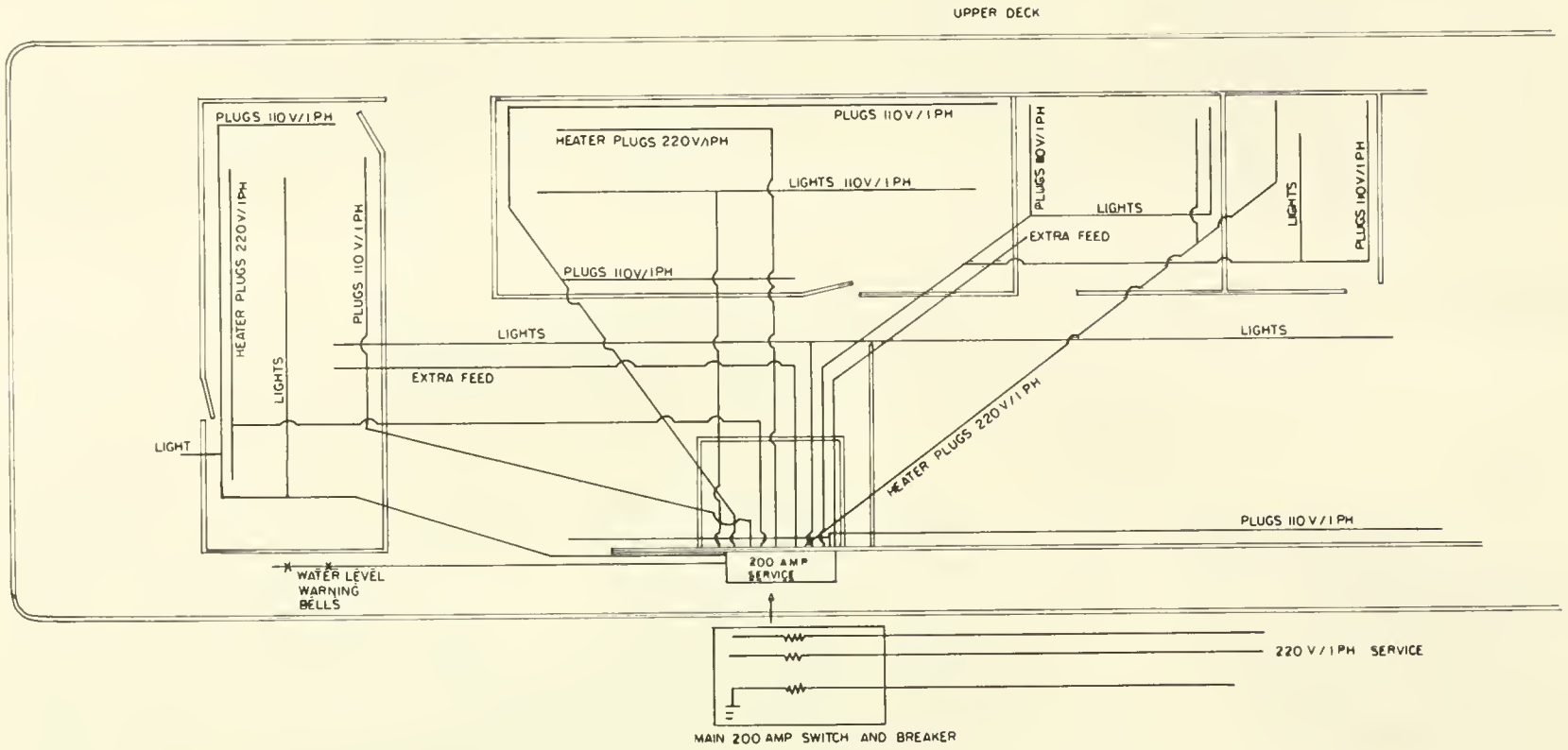


Main deck



Lower deck

Figure 3.—Diagram of water circulation systems on main and lower decks of facility.


UPPER DECK
PLUGS 110V/1PH
HEATER PLUGS 220V/1PH
LIGHTS
PLUGS 110V/1PH
LIGHT
WATER LEVEL WARNING BELLS
PLUGS 110V/1PH
HEATER PLUGS 220V/1PH
LIGHTS 110V/1PH
PLUGS 110V/1PH
LIGHTS
EXTRA FEED
PLUGS 110V/1PH
LIGHTS
EXTRA FEED
LIGHTS
PLUGS 110V/1PH
LIGHTS
HEATER PLUGS 220V/1PH
PLUGS 110V/1PH
200 AMP SERVICE
220V/1PH SERVICE
MAIN 200 AMP SWITCH AND BREAKER

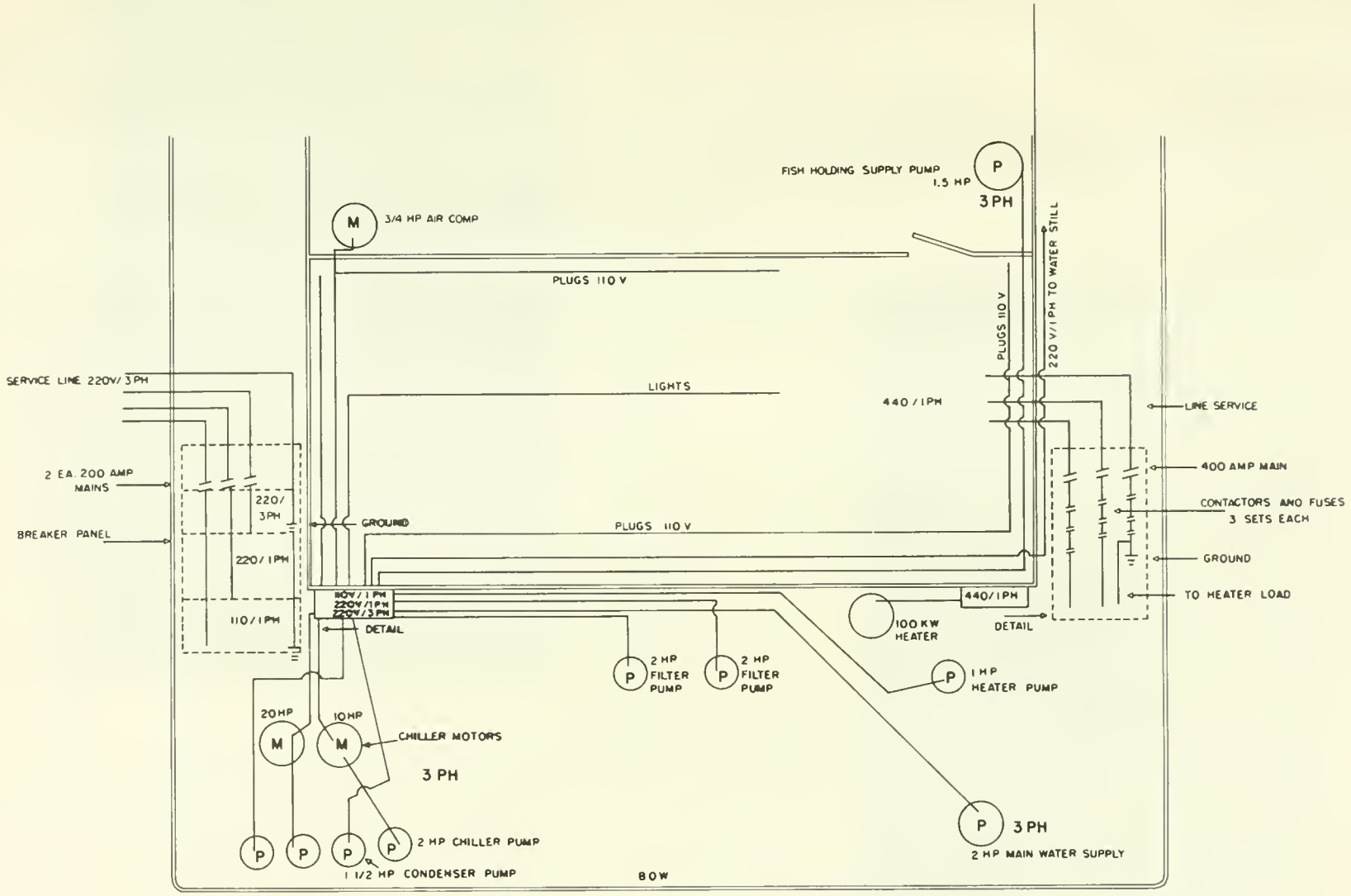


Figure 4.—Diagram of electrical service to main deck of facility excluding bow section (top) and bow section (bottom).

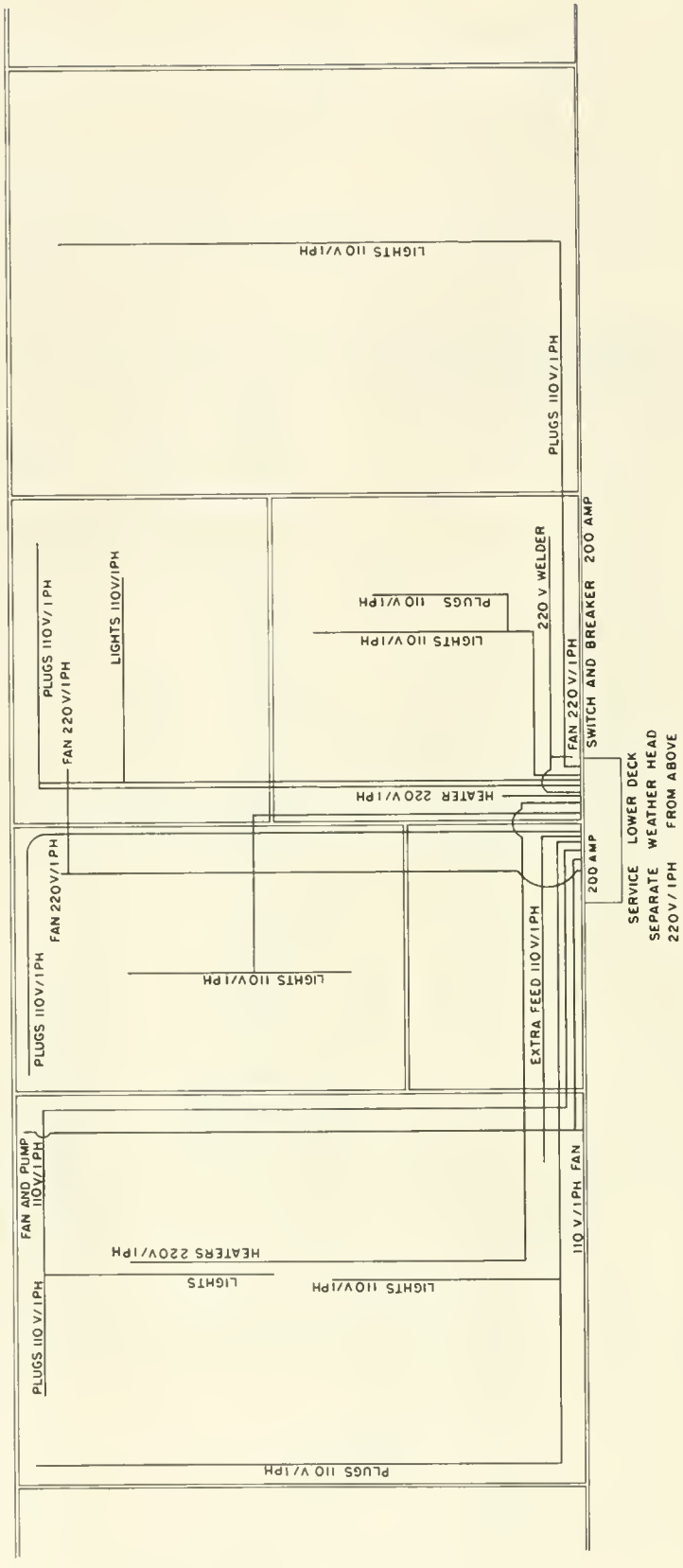
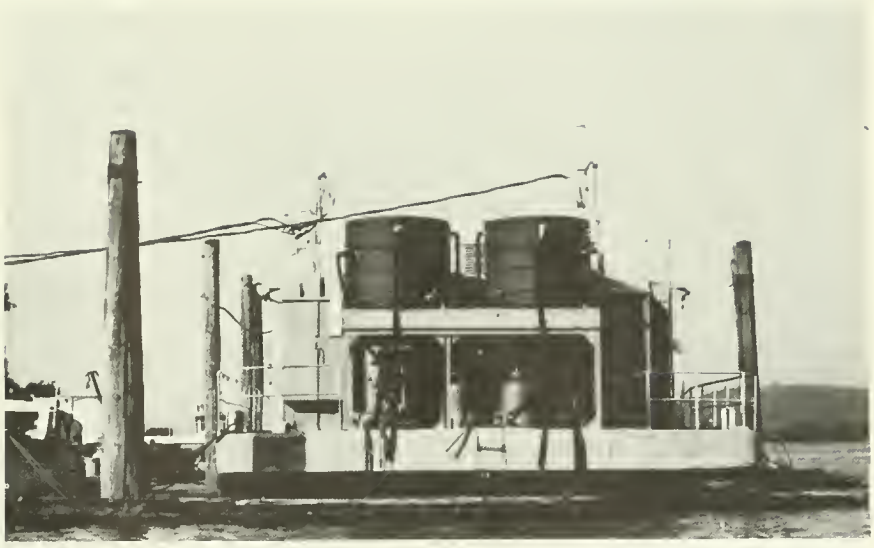


Figure 5.—Diagram of electrical service to lower deck of facility.

Figure 6.—Main deck layout.



a. Forward deck.

b. Fish holding.

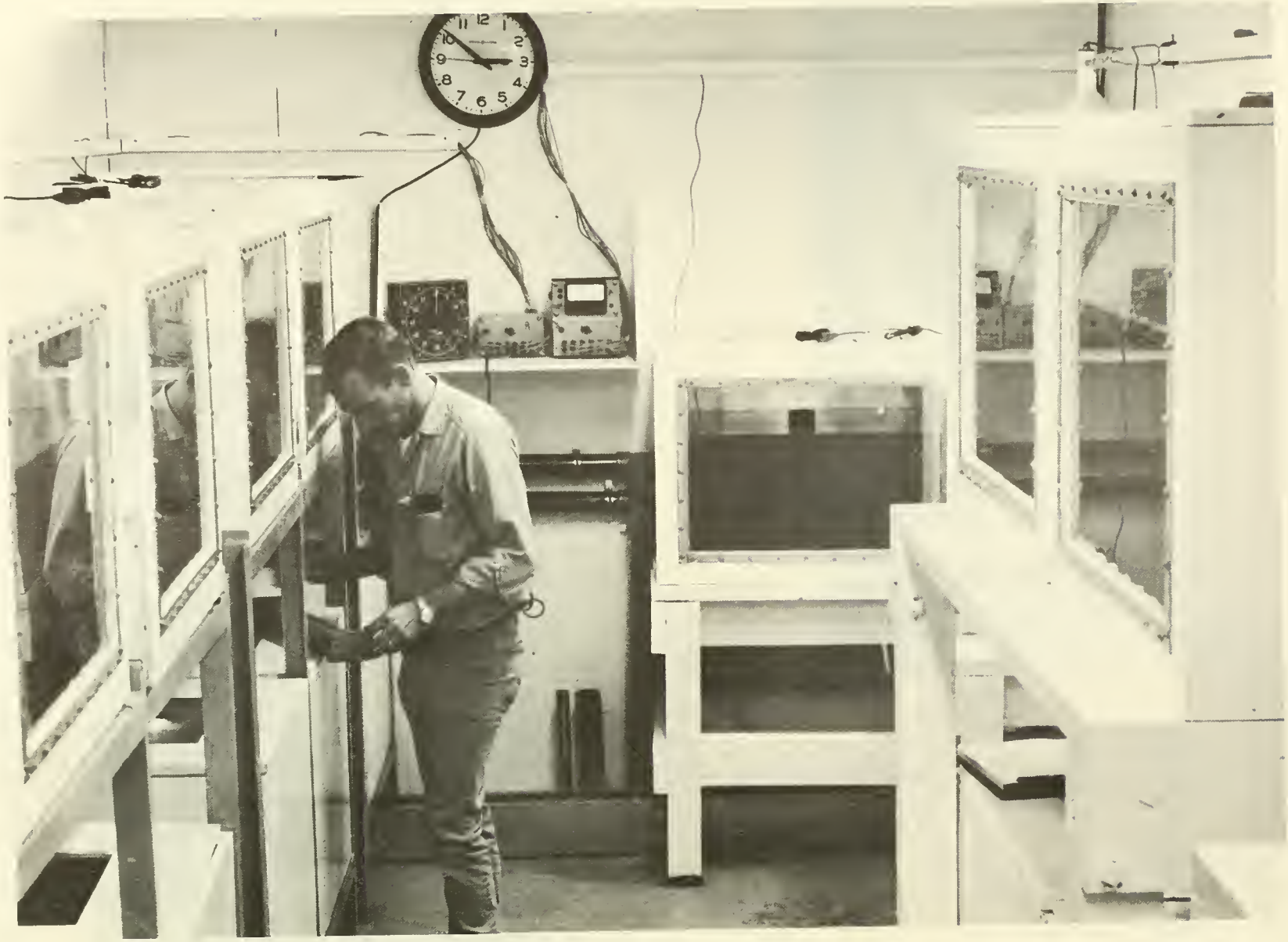


Figure 7.—Main deck—wet laboratory.

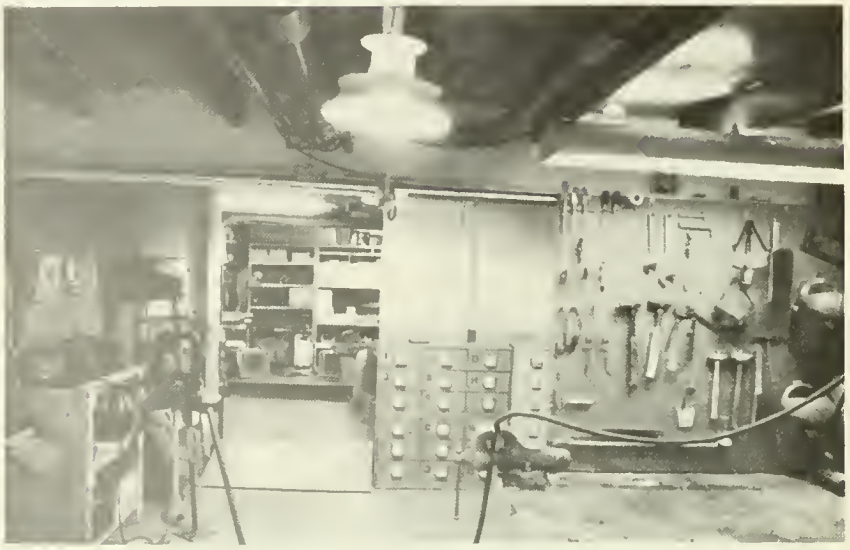
Figure 8.—Main deck layout.

a. Office.

b. Loading and display room.

Figure 9.—Maintenance shops of the lower deck.

a. Outboard motor.



b. Welding.

c. Woodworking.

Figure 10.—Lower deck (top) and conference room (bottom).

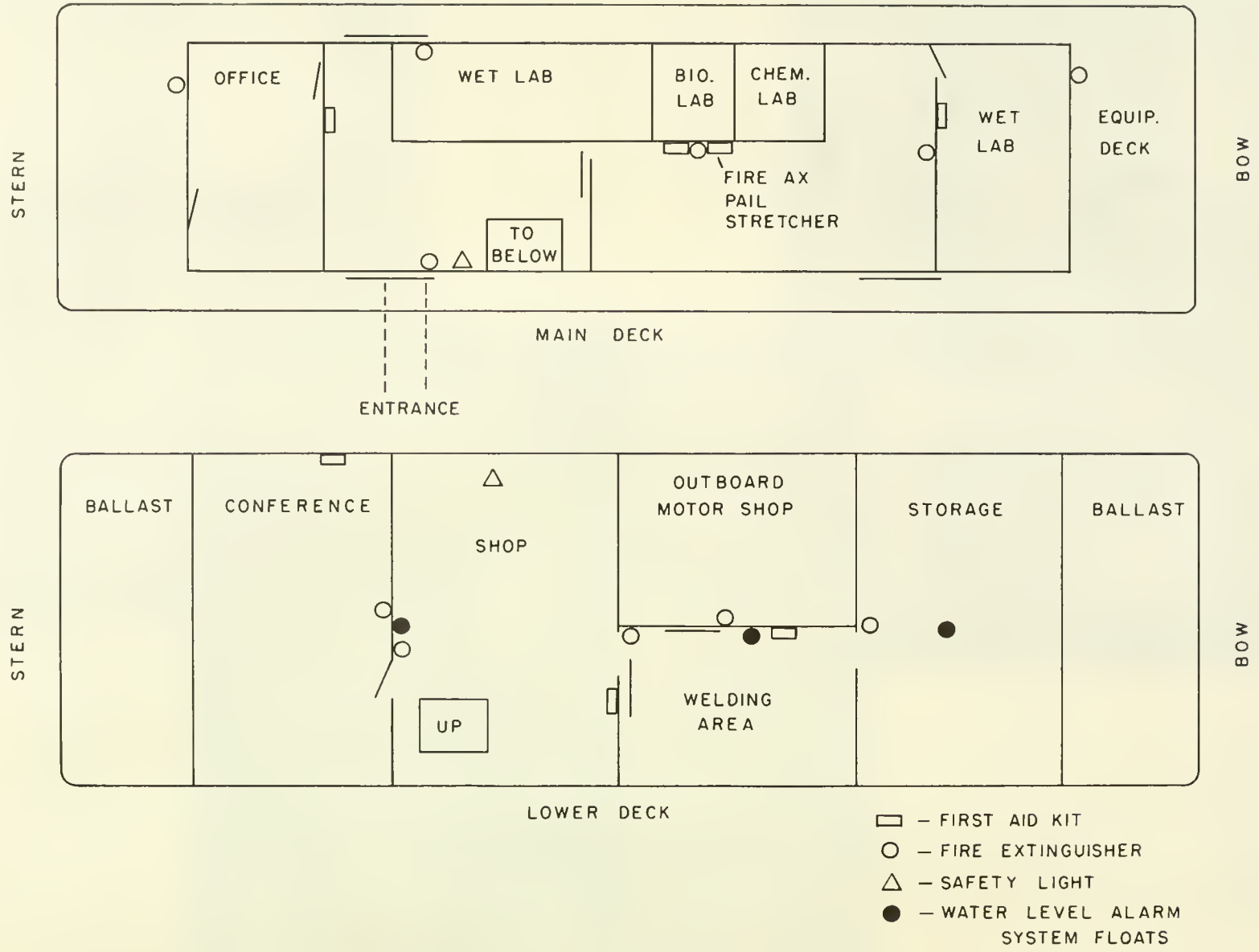


Figure 11.—Diagram of upper and lower decks of facility showing location of safety features.

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